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(NASA-CR-120288) REPORT ON SKYLAB -M551 SAMPLES (Battelle Columbus Labs., Ohio.) ~~39~~ 37 p HC $5.00 CSCL 11F

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REPORT ON SKYLAB-M551 SAMPLES
CONTRACT NO. NAS-8-28725

The review meeting held at MSFC was attended on July 19. Skylab specimens S/N-106, S/N-129, and S/N 145 were hand carried to Battelle following that meeting. A post flight series of ground characterization specimens, S/N-110, S/N 130 and S/N 147 were received at Battelle in August. Sections from the Skylab samples for examination at MSFC and others were returned to MSFC by Mr. Lovey on July 26. Similar sections from the post flight ground characterization samples were returned to MSFC September 10th.

SPECIMEN PROCESSING

Processing of the specimens at Battelle has followed the procedures previously developed and demonstrated in processing ground characterization samples. To datevisual examinations, thickness and distortion measurements, radiographic inspection, sectioning, and optical metallographic examination have been completed.

RESULTS

Results of the thickness and distortion measurements are shown in Tables IV-1 and IV-2[a]. Good agreement with intended dimensions was observed except for the two tantalum discs. The thickness variation in the cut and ramp regions of these discs may have influenced the extent and nature of cutting. The

(a) Table and Figure numbers intended for Final Report.

TABLE IV-1. THICKNESS MEASUREMENTS - M551

Location in Degrees	Thickness, Inch					
	Aluminum		Stainless Steel		Tantalum	
	S/N 129	S/N 130	S/N 106	S/N 110	S/N 145	S/N 147
0-30	.025	.024	.026	.025	.022	.018
30-60	.025	.024	.025	.025	.020	.018
150-180	.120	.119	.121	.120	.038	.036
180-210	.119	.119	.121	.120	.037	.036
210-240	.119	.119	.121	.119	.037	.036
240-270	.249	.246	.250	.248	.063	.063
270-300	.249	.246	.249	.248	.063	.063
300-330	.249	.247	.249	.248	.063	.063
330-360	.248	.247	.248	.248	.063	.063

TABLE IV-2. DISTORTION MEASUREMENTS-M551

Location in degrees	Distortion, inch x 10^{-3} [a]											
	Aluminum				Stainless Steel				Tantalum			
	S/N 129		S/N 130		S/N 106		S/N 110		S/N 145		S/N 147	
	In	Out	In	Out	In	Out	In	Out	In	Out	In	Out
0	-2	0	+2	0	-4	0	-1	0	-6	0	-5	0
30	+1	+12	+7	+23	-9	+6	-1	-1	+4	+6	+4	-2
60	-3	+15	+3	+27	-9	+10	-1	+12	-4	+1	-7	-3
90	0	+20	+6	+22	-3	+7	-5	+3	-8	-5	-10	-7
120	0	+17	+5	+12	-7	-1	-10	-9	-10	-6	-11	-8
150	-1	+7	+3	+5	-7	-3	-6	-7	-10	-5	-11	-7
180	-4	0	+3	+6	-8	-4	-5	-3	-10	-7	-10	-7
210	-5	+1	+5	+13	-8	-1	-4	+1	-10	-7	-10	-8
240	-5	+4	+5	+15	-7	+3	-2	+5	-9	-7	-9	-7
270	-3	+4	+5	+12	-4	+4	0	+6	-8	-6	-7	-7
300	-1	+2	+4	+7	-2	+4	+1	+5	-7	-7	-5	-4
330	-2	+4	+4	0	-4	+1	(b)	-4	-8	-6	-6	-1

(a) + = distortion toward electron gun
 - = distortion away from electron gun

(b) No measurement, probe in cut or dwell region.

distortion measurements appear to indicate generally similar behavior in the Skylab and ground characterization samples. The radiographic inspection revealed the same defects that could be detected visually. No abnormal conditions were shown up in the radiographs. Additional results follow in separate sections on each material.

Aluminum Discs

Samples S/N 129 (Skylab) and S/N 130 (ground) are shown in Figures IV-1 through IV-4. The most significant difference in appearance is the change in the surface along the full penetration region. The skylab samples (Figure IV-3) exhibits a bright center region free of oxide. In contrast the ground characterization sample (Figure IV-1) is covered with small oxide particles. These particles are believed to be transported from the back surface of the disc by gravity induced convention. Initially both surfaces of the aluminum are covered with a thin film of aluminum oxide. The oxide on the front surface is removed from the weld center by impingment of the electron beam. Oxide on the back surface is not subject to the same conditions and is free to interact with the molten aluminum weld pool. In a gravity field the lower density oxide will tend to float to the highest point in the molten weld pool which is on the front surface. In fact, all of the ground characterization samples have exhibited evidence of this occurring where a full penetration weld was obtained. In zero gravity, the density difference is not a factor, and consequently, oxide remains on the back surface.

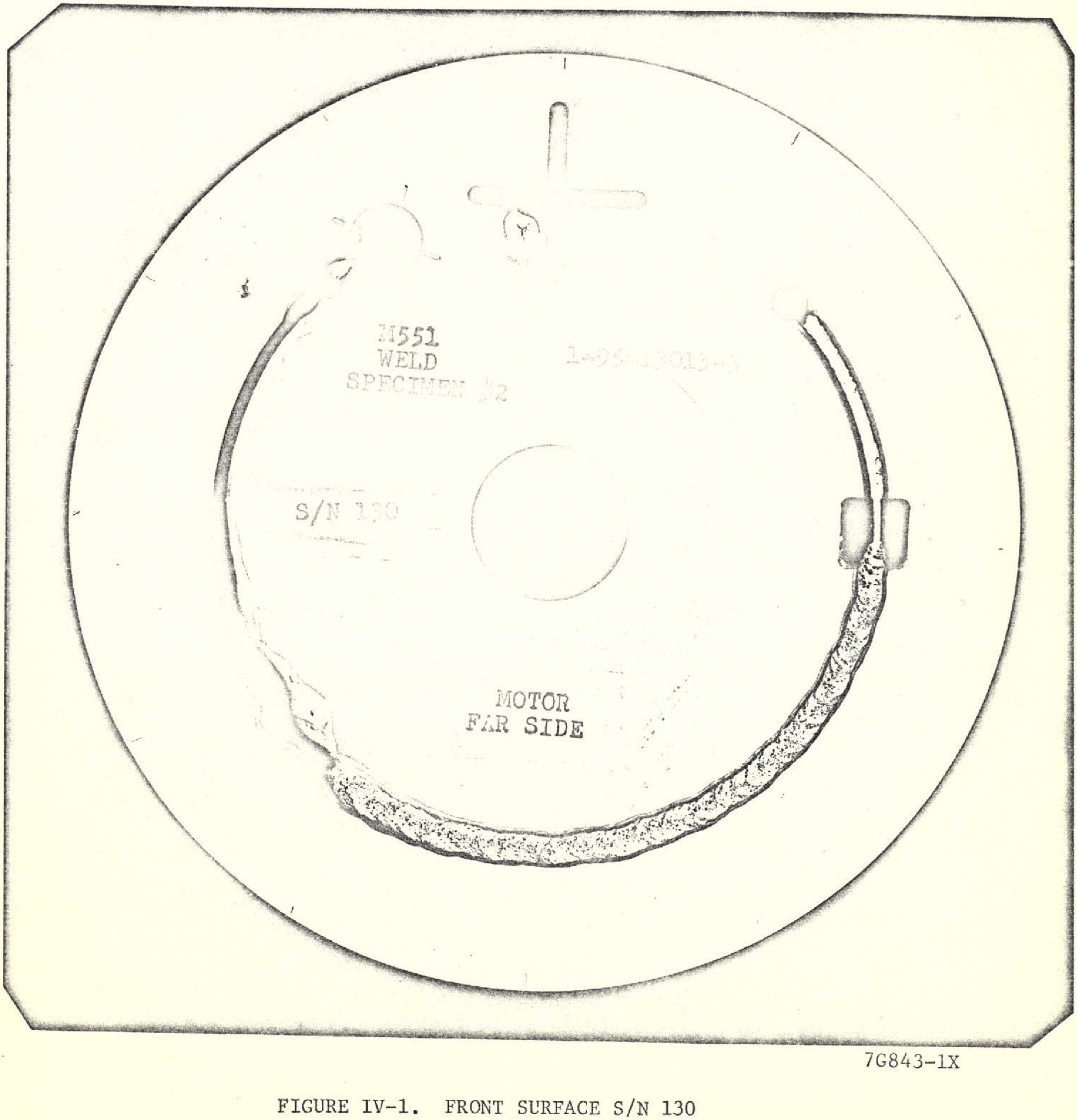

FIGURE IV-1. FRONT SURFACE S/N 130

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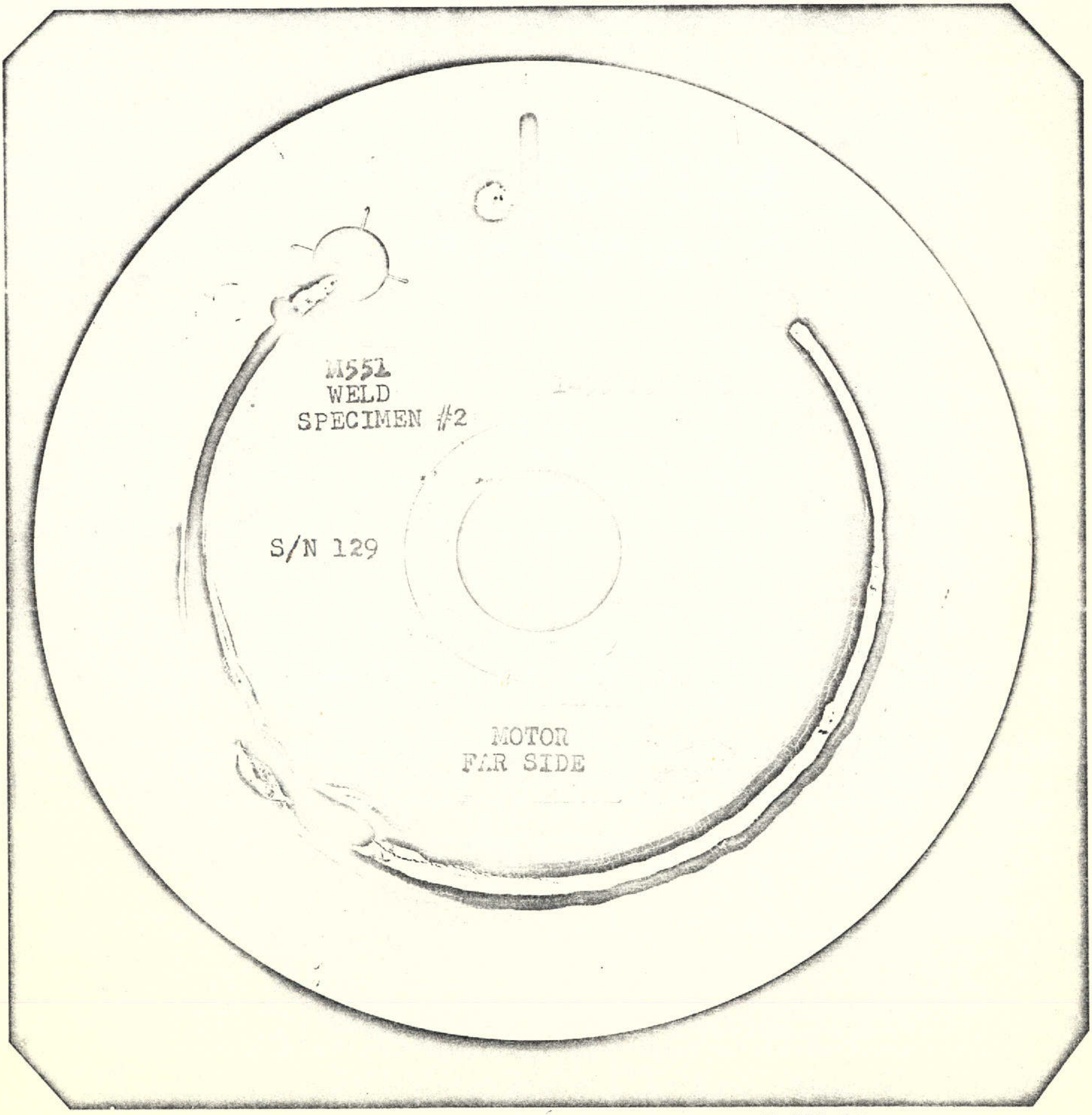
FIGURE IV-2. BACK SURFACE S/N 130



7G837-1X

FIGURE IV-3. FRONT SURFACE S/N 129

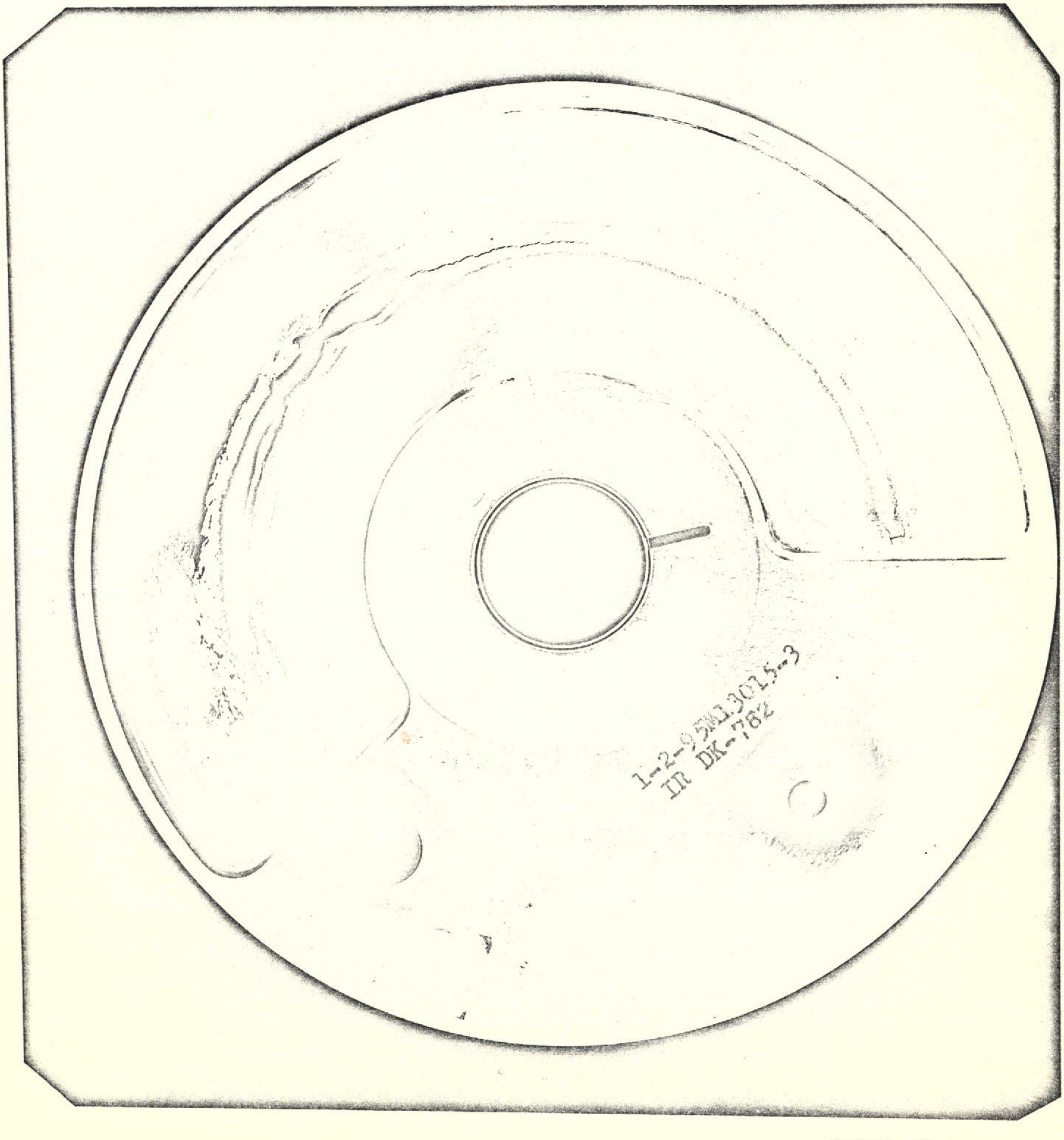


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FIGURE IV-4. BACK SURFACE S/N 129

Comments made during the visual examination of the aluminum discs follow:

Front Surface S/N 130

At o degrees the target shows good positioning of the electron-beam; almost exactly dead center. There is a short weld region on the tungsten which is not contaminated by aluminum which did flow back onto the outer edge of the target for a short distance. A short length of weld then exists up to the point where cutting starts. There is a shrinkage crack in the termination of this short length of weld. The initial width of the cut region is 6 millimeters. For most of the rest of the cut the cut narrows to approximately 2 millimeters in width. Material from the cut region formed a bead on either side of the cut. This bead is much heavier on the inside edge of the cut. Several more massive accumulations of molten metal exist along the cut region. One at about 20 degrees, one at about 70 degrees, and one at 95 degrees. The region between about 80 and 100 degrees is very erratic in appearance with the cut width varying considerable and a very massive ball of molten material on the inside edge, as mentioned previously at 95 degrees. Welding starts at about 100 degrees with only a very slight indication of a starting crack. Weld ripples are fairly pronounced although the surface is quite molted with a brownish spot-type deposit in the center region with a dark appearance on the outer region of the weld. The weld continues fairly uniform in appearance until the molybdenum tracer region is reached. Initially at that point there is a depression in the weld surface and numerous small hairline cracks are apparent in this area. Once the weld passes by the tracer region, it again assumes a uniform appearance with clear surface ripples and very little evidence of the brown spotty material in the center. The center region for the remainder of the weld is basically bright and clean; the brown material appears to have remianed along the edges of the weld. The weld terminates in the finish hole with some slight cracking in the weld crater. The initial weld width is 8mm, it then narrows to 6mm(full penetration) then to 4mm (partial pen). The dwell region was focused slightly to the inside and beyond the intended 330 degrees. The bulk of the dwell which is basically circular in appearance, is completely outside of the two legs of the molybdenum target. The dwell extends under these two legs but does not appear to have reacted with either leg very much. There are a number of shrinkage cracks in the center of the dwell region which is depressed. In general, the dwell periphery is raised above the surface of the plate being approximately even with the surface at the top. The center of the dwell is quite bright with the outer fringes of the molten zone appearing with a light brownish surface coloring. The dwell measures 15 X 12mm.

Back Surface S/N 130

At the target there is nothing of significance. The cur area looks much like the top surface but is not as smooth nor is there as much molten metal attached below the plate surface as on the top. The inner surface is much dirtier than it is at the top. When welding starts, there is no evidence of the hot tear on the under surface. The initial width of the weld on the under surface is quite wide, measuring approximately 8 millimeters. At about 140 degrees the width narrows to about 5 millimeters and stays essentially at that width.throughout the remainder of the full penetration section. Throughout this region the under surface is somewhat erratic in appearance. There is a small crack evident at the termination of the full penetration weld. There is no indication of welding on the partial penetration region except that the area around the termination hole is slightly discolored. There is essentialy no evidence of the dwell region on the back side of the plate. A slight indication of the existence of this region can be seen without magnification. There is no difference in the surface appearance when looked at through the microscope.

Front Surface S/N 129

At zero degrees, the target shows evidence of aluminum material which has run back onto the target area for a distance of about 3-1/2 millimeters. The initial weld area, which is solid, is approximately 7 millimeters in length. At this point, the cutting action begins as intended. The initial width of the cut region is 6 millimeters. Throughout the rest of the cut, the kerf narrows to approximately 2 millimeters in width. Material from the cut region has formed a bead on either side of the cut. This bead is heavier on the inside edge of the cut. At about 80 degrees, there is the first large ball of material which occurs on the inside edge. At about 90 degrees, there is a large ball of material collected on the outside edge of the cut. At 120 degrees welding starts. For the initial portion of the weld there is a hot tear along the weld centerline. The initial upper surface of the weld is relatively rough. The hot tearing condition continues until about 150 degrees. Surface roughness is still apparent and the weld surface is not depressed, but actually raised. At approximately 230 degrees, cracks are again on the upper surface at this point and between this point and 240 degrees there is some depression of the weld surface apparent. Cracks are evident and traces of the molybdenum tracer present in this region are apparent on the weld surface. The first evidence of ripples on the weld surface occurred just beyond about 240 degrees. Weld appearance is fairly uniform from this region on to the termination hole. There is a small crater crack at the termination hole. The weld surface ripples are more apparent in the partial penetration region of the plate. Throughout the length of both the cut and weld region, there is apparent continuous cracking of the oxide film on either side of the weld. This film has a brownish appearance. The dwell region appears to be centered approximately 5 degrees off of the intended centerline and about 2 millimeters outside of the intended focal point. There is some cracking evident in the dwell region. The dwell measures 16 millimeters in length in the radial dimension and 20 millimeters in length along the chord dimension. The dwell is oval in shape with a slight depression at the center.

Back Surface S/N 129

At the target there is nothing of significance. The cut area looks very much like the top surface but is not as smooth and to some degree, looks a little dirtier. Where welding starts, the hot crack is apparent on the undersurface extending from the start of the weld until approximately 150 degrees. Ripples appear to be evident on the under weld surface starting at approximately 180 degrees. These ripples are quite elongated. Small check like indications in the heat affected zone are evident between 210 degrees and about 225 degrees. These are possible heat-affected zone cracks, but this cannot be confirmed visually. The cracks evident on the top surface at about 240 degrees are also evident on the lower surface. From 240 degrees to the weld termination hole, there is no evidence of welding, however, the area around the hole itself is slightly discolored.

In the dwell region there is no absolute evidence that melting occurred through to the back side. This region is slightly different in appearance from the remainder of the plate with the machine markings being not quite as clear. It would appear that the surface of this region has a fine grained structure.

Sectioning

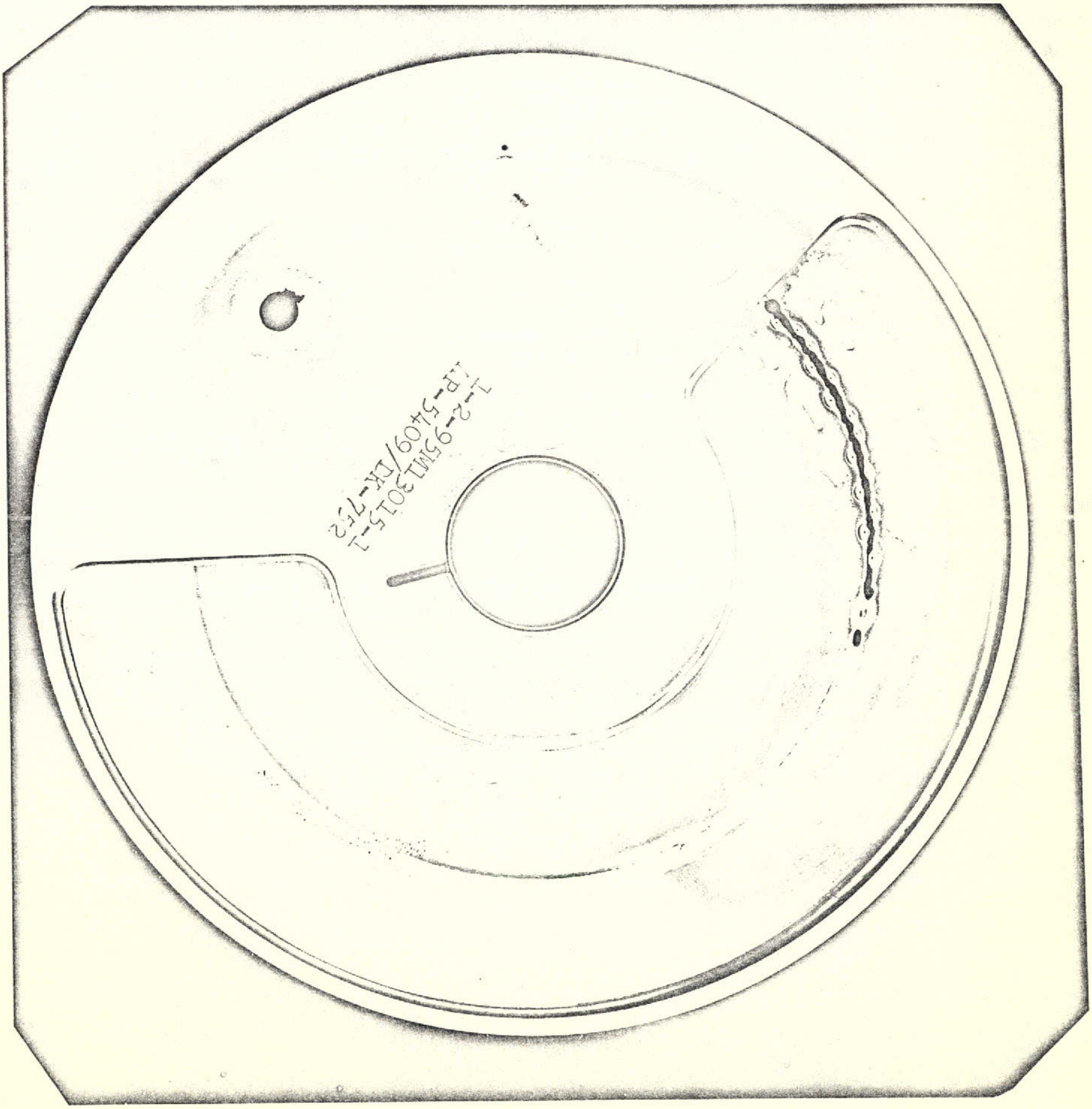
Both aluminum discs have been sectioned as shown in Figure IV-5. All sections have been mounted and examined. Results of there examinations will be reported in the future.

Stainless Steel Discs

Samples S/N 106 (Skylab) and S/N 110 (ground) shown in Figure IV-6 through IV-9. Comments made during visual examination follow:

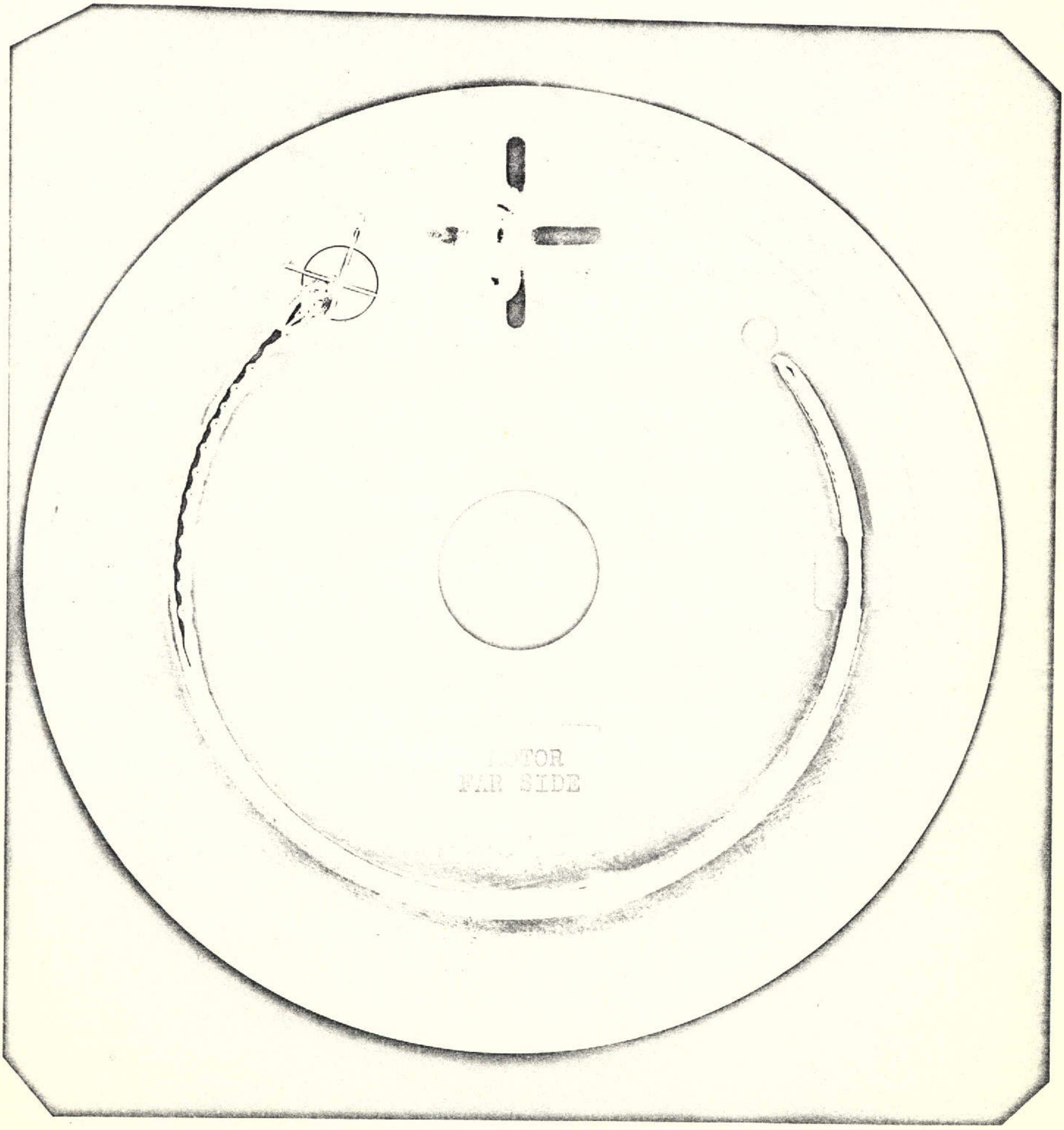
7G839-1X

FIGURE IV-6. FRONT SURFACE S/N 106



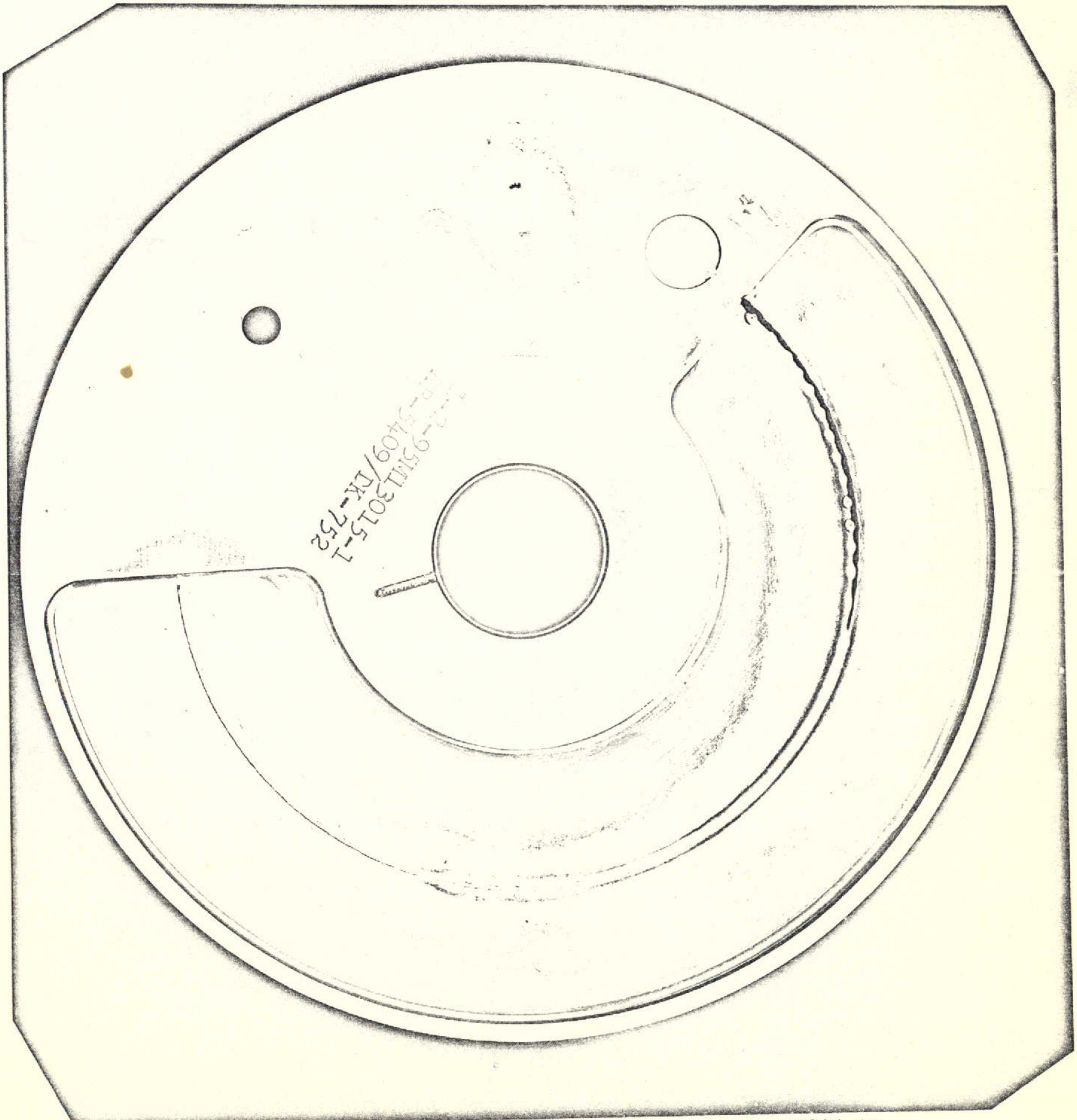
7G840-1X

FIGURE IV-7. BACK SURFACE S/N 106



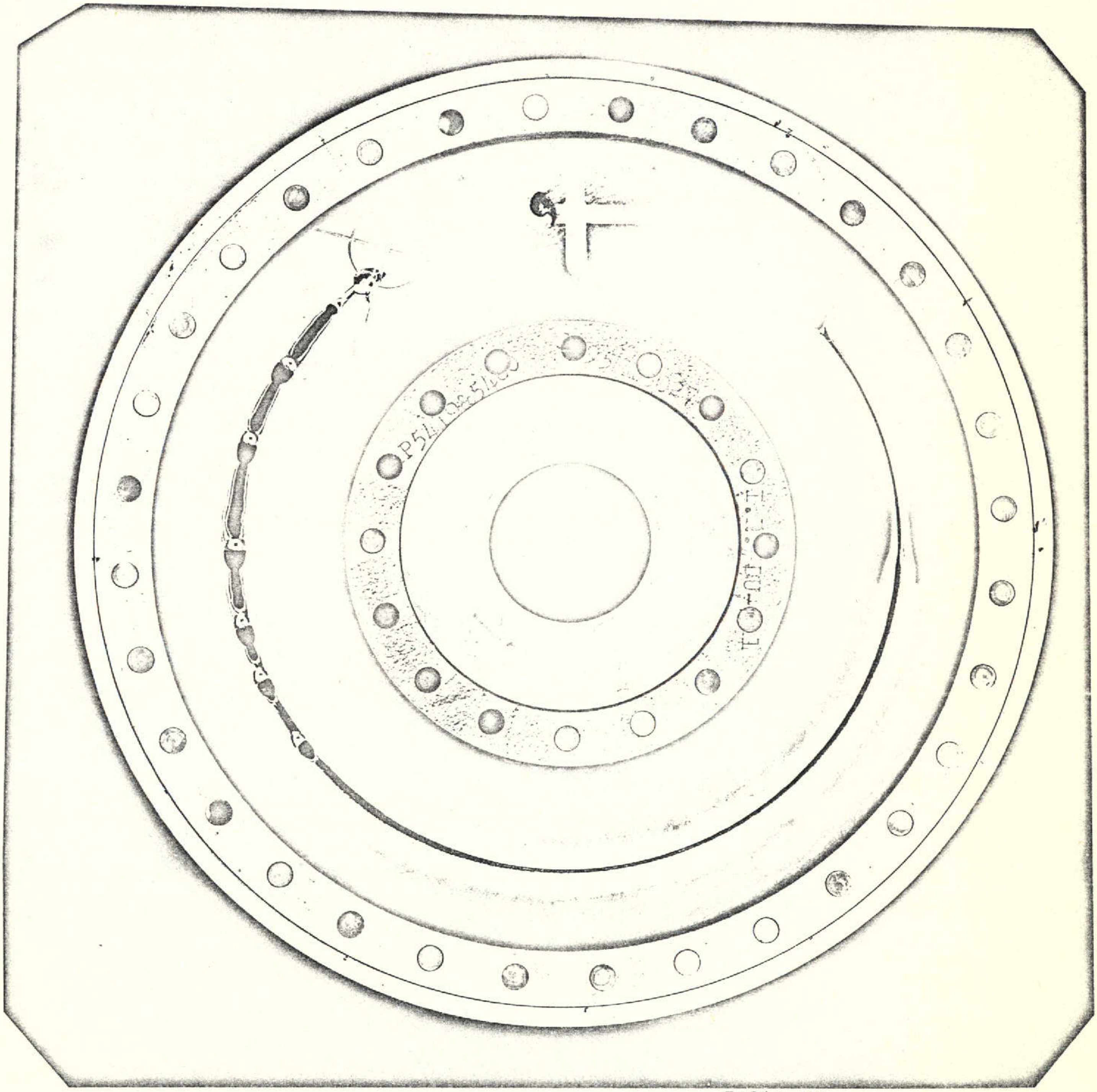
7C845-1X

FIGURE IV-8. FRONT SURFACE S/N 110



7G846-1X

FIGURE IV-9. BACK SURFACE S/N 110



7G841-1X

FIGURE IV-11. FRONT SURFACE S/N 145

Front Surface S.N 100

At zero degrees, the target shows evidence of having been used to locate the beam with a slight melted region almost exactly on the center. The flow back of the weld appears to extend all the way from the edge of the target back to the center. Another region on one of the grooves appears to contain molten stainless steel which has flowed back in almost a brazing type flow. The surface of the tungsten shows evidence of having reacted with this stainless steel and also evidence of two cracks - one on either side of the main weld deposit. A solid weld region extends from the target to the point where the thickness decreases and cutting commences. The appearance of the cut on stainless steel is quite different from that in aluminum. In the stainless steel, the molten metal from the cut region has accumulated periodically in essentially circular type balls. The first ball appears on the inside surface of the cut, followed by a large ball on the outside, another on the inside, and another on the outside. The width of the cut tends to vary considerably ranging between 1 and 2 millimeters. The pattern of the ball deposits being on the inner or outer cut surface is fairly uniform throughout the length of the cut region. At approximately 70 degrees, there is a complete bridge across the cut region. This is followed by one small hole and immediately followed by the start of the full penetration weld. As soon as the weld initiates, surface ripples which are very elongated, are immediately apparent. After an initial variation in the width, the weld is quite uniform in appearance until about 105 degrees. At that point, a rather severe undercut condition develops along the inside edge. This undercut appearance continues essentially unchanged for the remainder of the weld. There is no similar evidence of undercutting on the outside edge of the weld, and no significant variation in weld appearance from the initiation of the undercut condition until its termination at the hole. There is slight evidence on the opposite side of the hole of the electron beam having been on when the disc was rotated to that point. There are occasional instances where small spatter particles can be seen adhering to the inside edge adjacent to the weld. Surface appearance of the weld is typical for a stainless steel electron beam joint with evident dendritic patterns at higher magnifications. There is no evidence whatsoever of any cracking or weld defects other than the undercut. The focal point for the dwell area appears to have been almost exactly at the center of the molybdenum tracer target. It is slightly inside but still within the target region. The dwell is elongated - the long axis essentially parallel to the radial direction. There is an obvious buildup of material above the surface surrounding the entire dwell region. Solidification ripple patterns are quite evident along this built up region. The center portion of the dwell shows no evidence of ripple patterns for approximately half of the total area. A large cavity and crater are evident at the center of the dwell. The dwell measures approximately 19 millimeters along the long axis and 10 millimeters on the short axis.

Front Surface S/N 106

The target area indicates nothing of significance except slight brownish discoloration. The cut region starts immediately when the thin section is reached. The appearance of the balls along the cut region is quite similar to their appearance on the upper surface, although there is slightly more grayish discoloration on the lower surface. Where the weld commences, a ripple pattern again is immediately evident. The full penetration weld occurs with fairly uniform width penetration from the start of the weld to 120 degrees. At this point, penetration or width of the bead narrows and there is some buildup on the under surface. Full penetration stops at approximately 140 degrees. This situation continues until at approximately 200 degrees there is a single small circular indication of full penetration. It is clear on the under surface where welding has occurred, even in those regions where penetration is not achieved. It would appear that there is a slight drop through on the underside even when penetration is not clearly evident. There is no evidence of the weld on the under surface in the partial penetration region. Some discoloration is evident on the surfaces surrounding the underside of the termination hole. Full penetration was achieved on the dwell but the overall size of the molten spot is much smaller than on the top surface. Its basic appearance is quite similar with evidence of ripple formation on the edges with a single very smooth surface center region which seems to have solidified all at once. Although it is not as obvious, the region of penetration on the lower surface is also basically oval or oblong in shape. The long axis measured approximately 7 millimeters and the short axis just under 6 millimeters. The general appearance of the contour on the under surface is a very shallow depression with the edges being possibly slightly raised above the original surface.

Front Surface S/N 110

At 0 degrees the target has been used to locate the beam with a melted region almost exactly on center. Flow back of molten stainless steel has occurred all the way from the edge of the target back to the center. A solid weld region extends from the target to the point where the thickness deceases and the cutting commences. The cut width is 1mm. In the cut region the surplus molten metal has accumulated in essentially circular balls. In this specimen, all the balls lie along the inside edge of the cut region. There are 13 of the ball accumulations along this edge. The last of the ball accumulations is slightly beyond 60 degrees, although the actual welding does not start until about 75 degrees. As soon as the weld initiates the surface ripples which are very elongated are immediately apparent. Undercut along the inside edge is also immediately apparent. Starting at about 130 degrees the undercut is not as severe and, in fact, may not exist although there is an occassional indication of undercut still along the inside edge. At about 160 degrees, there is a perturbation in the surface appearance related to a mass change as the disc rotates. At the change in thickness going from the thin to the thickest material, there is a change in the bead appearance with the top surface appearing to be more elevated in the partial penetration region. The weld terminated slightly short of the termination hole with a shallow elongated crater. There are occasional instances where small spatter particles can be seen adhering to the inside edge adjacent to the weld. Surface appearance of the weld is typical for stainless steel electron-beam joint.

There is no evidence of any cracking or weld defects other than the undercut. The weld width initially is 1-1/2mm.,widening to 2.5mm. (full penetration) and then to 3 mm. (partial penetration).
The focal point for the dwell area appears to be slightly on the inside and slightly beyond the 330 degree position. However, the dwell is fairly well centered on the molybdenum tracer target. The dwell is elongated, the long axis essentially parallel to the radial direction. There is a build up of material above the surface of the plate in the lower portion of the dwell melt side. The upper portion is depressed below the plate surface. A large cavity and crater are evident at the center of the dwell but slightly toward the top side. The dwell measures approximately 18 millimeters along the long axis and 8 millimeters on the short axis.

Back Surface S/N 110

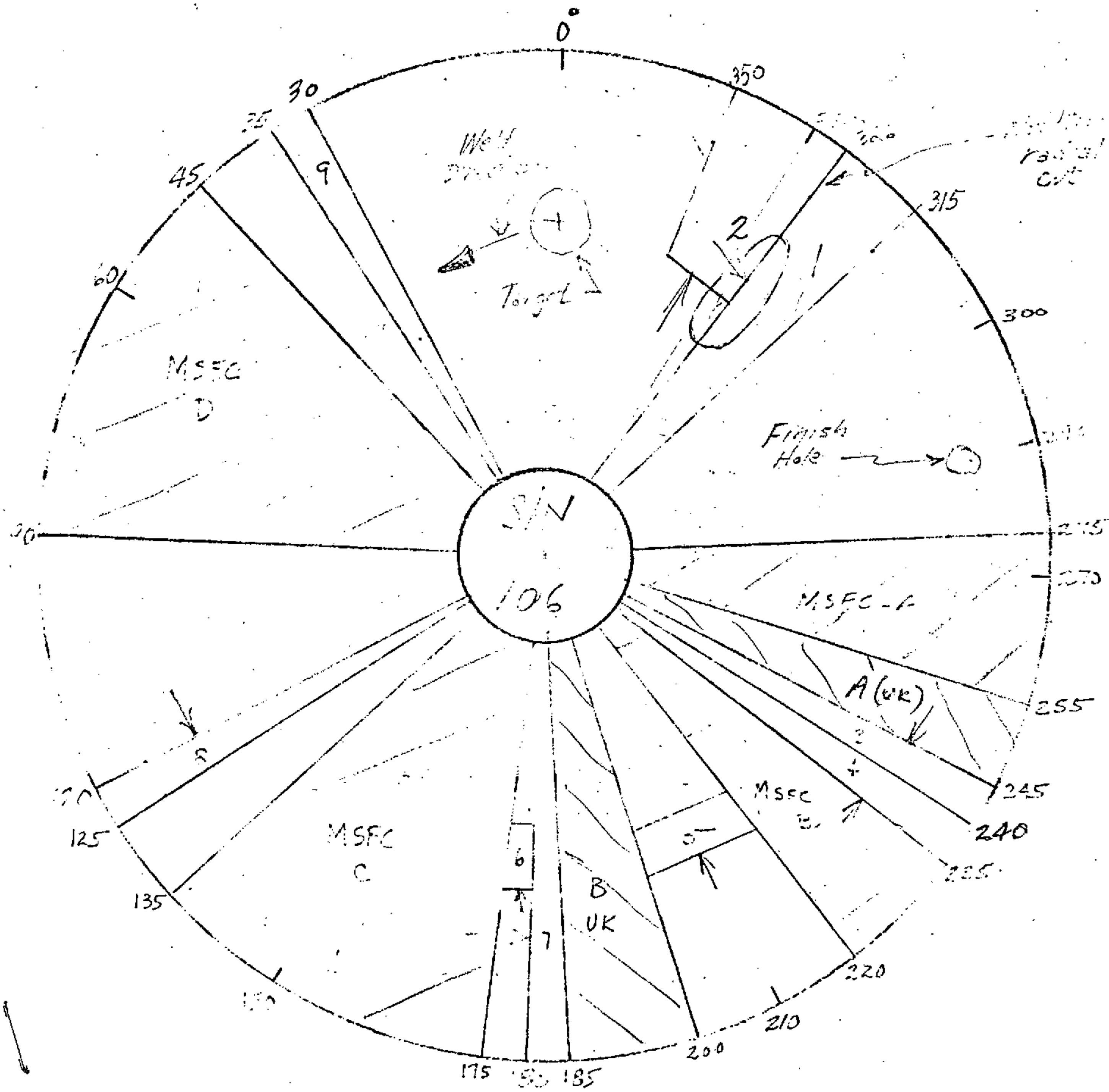
The target area is completely melted through slightly on the surface adjacent to the weld start. Penetration proceeds for a short distance and then stops until the cut region is reached. The cut region starts immediately when the thin section is reached. The appearance of the cicular balls along the cut region is quite similar to their appearance on the top surface. Where the weld commences, a ripple pattern again is immediately apparent. Starting at about 145 degrees, there is quite a bit of evidence of spatter adhering to the back surface. The same perturbation noted on the front surface due to the mass shift is also apparent on the back surface. Penetration is continuous throughout the length of the full penetration portion of the plate. At about the same point where spatter first starts, the underside bead contour begins to change getting slightly narrower and somewhat higher than it was in the earlier portion. There is no evidence of the weld on the under surface in the partial penetration region. Full penetration was achieved on the dwell but the overall size of the molten spot is much smaller than on the top surface. Its basic appearance is quite similar with evidence of ripple formation on the edges with a single very smooth surface center region which appears to have solidified all at once. The outermost edges of the dwell on the under surface are raised slightly above the plate surface everywhere except at the very top. The center region of the dwell is generally depressed. The long axis measures approximately 10 millimeters and the short axis 7 millimeters.

Sectioning

Both stainless steel discs have been sectioned as shown in Figure IV-10. All sections have been mounted and examined. Results of these examinations will be reported in the future.

Tantalum Discs

Samples S/N 145 (Skylab) and S/N 147 (ground) are shown in Figures IV-11 through IV-14. Comments made during visual examinations follow:



Sectioning plan S/N-106

FIGURE IV-10. SECTIONING PLAN
S/N 106

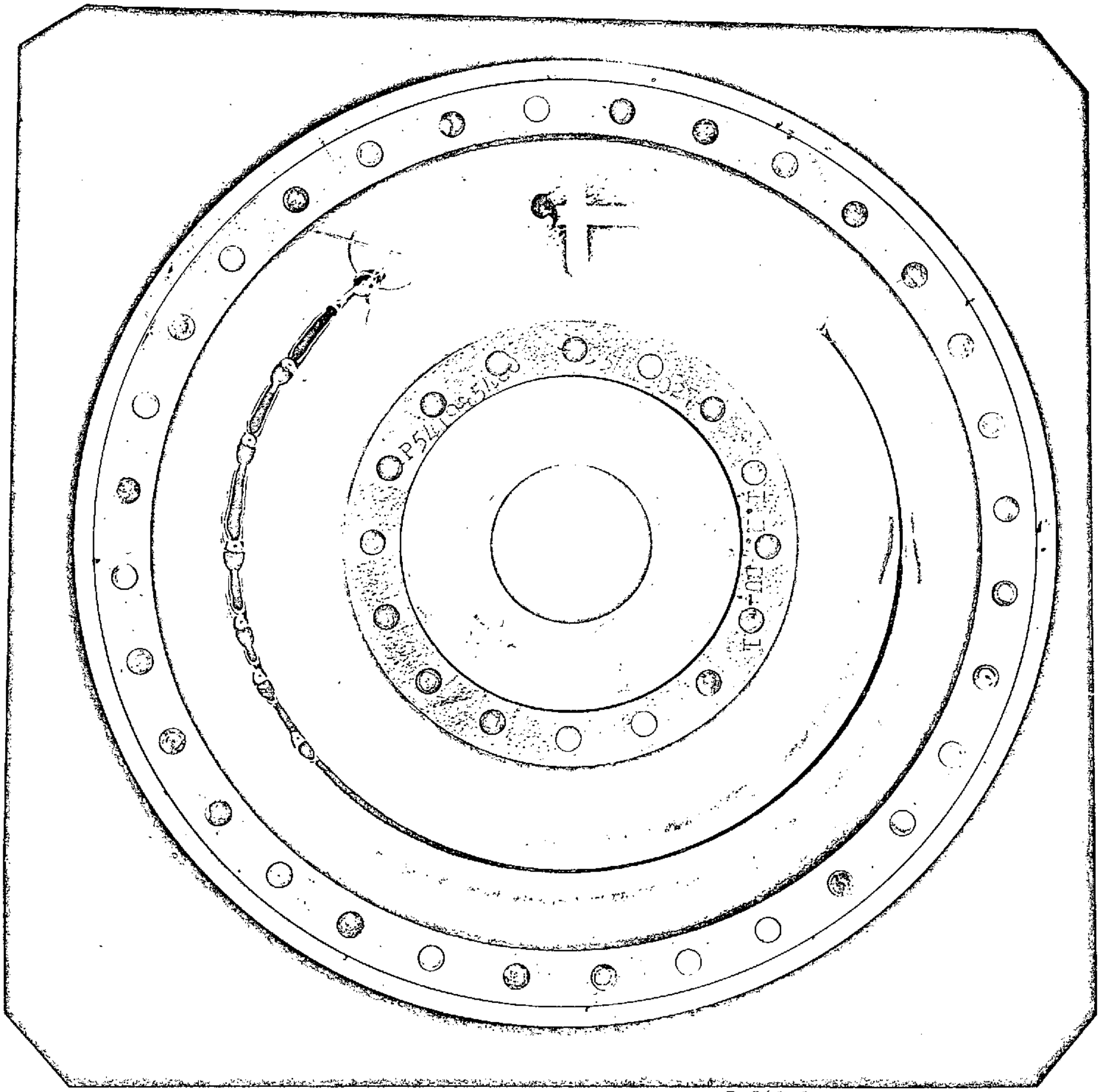


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FIGURE IV-11. FRONT SURFACE S/N 145

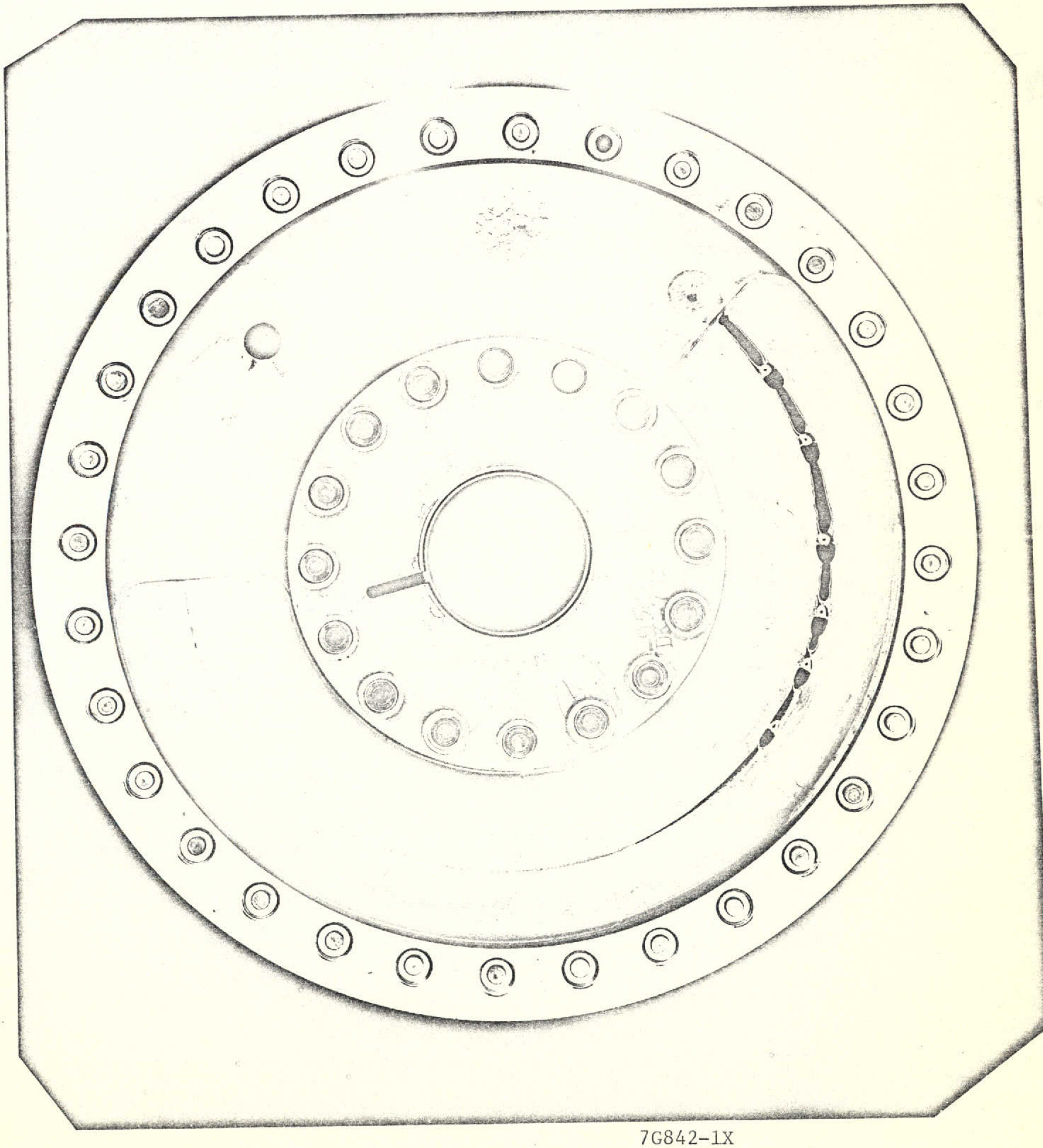

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FIGURE IV-12. BACK SURFACE
S/N 145

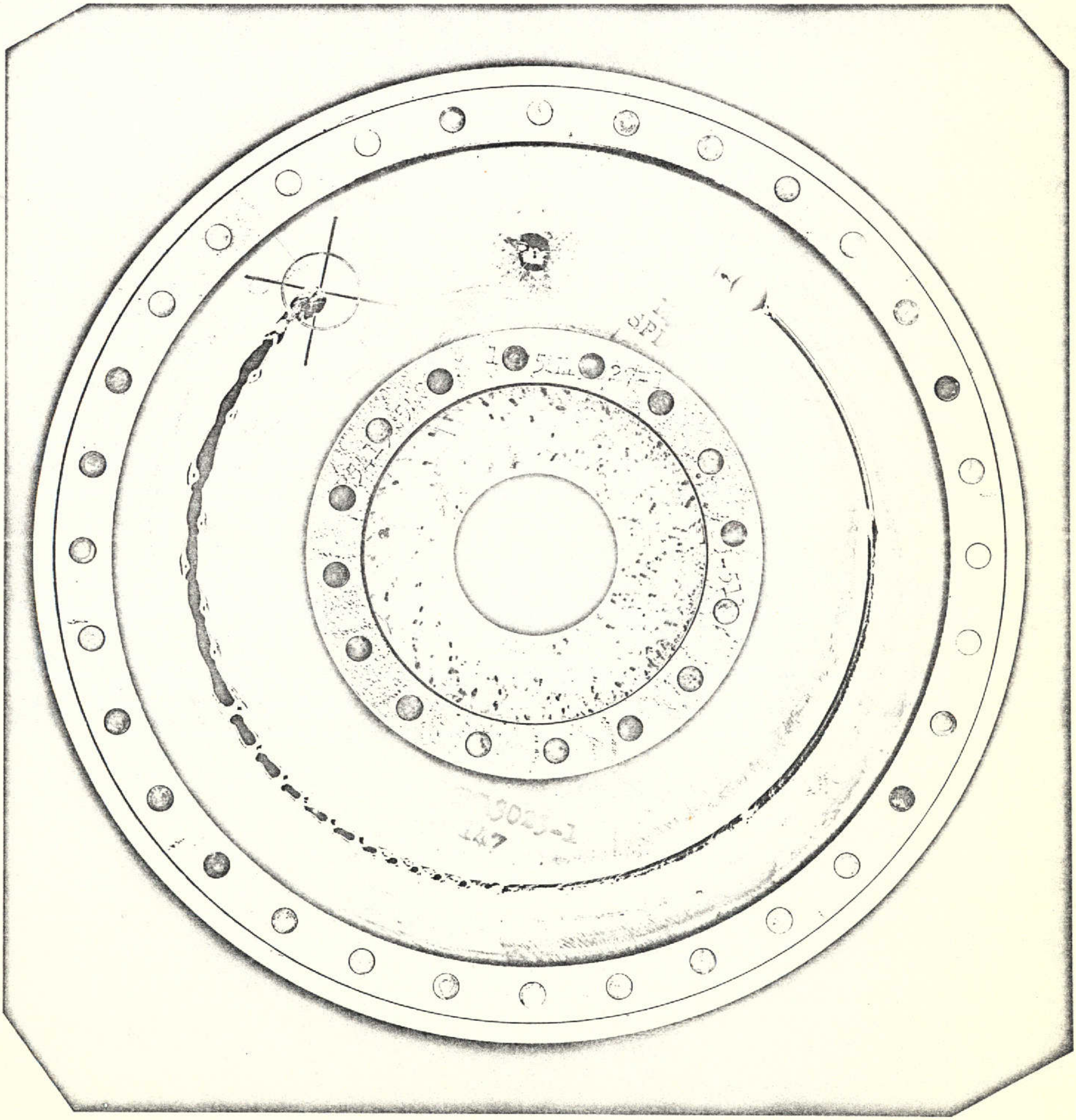

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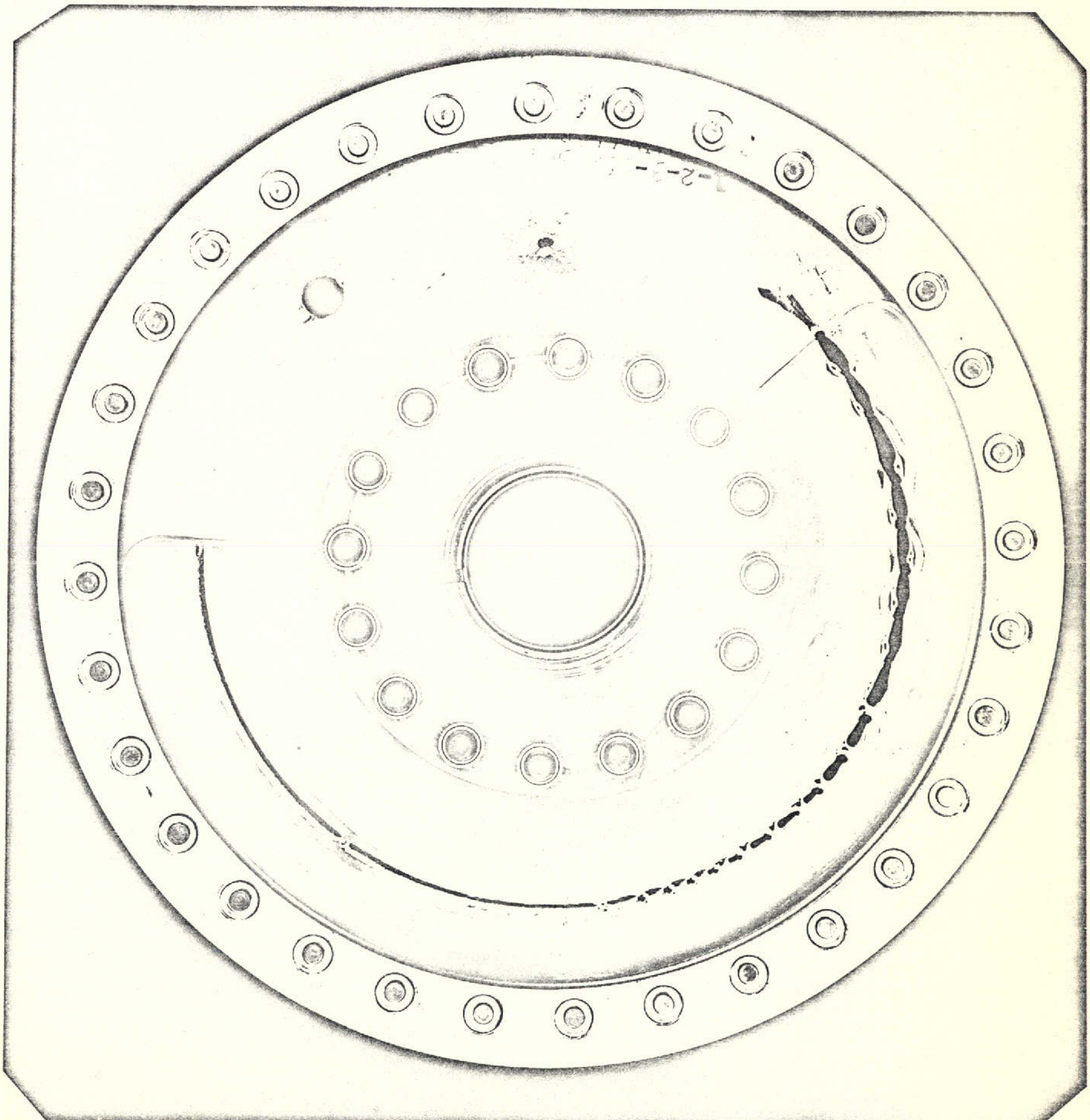
FIGURE IV-13. FRONT SURFACE S/N 147



7G848-1X

FIGURE IV-14. BACK SURFACE S/N 147

Front Surface S/N 145

The target is integral on this sample. The beam was initiated within the target area but a little beyond the zero point and slightly to the inside. The surfaces of the tantalum welds are beautiful, showing both a ripple pattern where the beam was started and clear evidence of the grain structure on all of the surfaces. There is no evidence of any discoloration or oxidation. The cut region appears to start immediately at the thin section and is bridged periodically by a ball of molten tantalum. These balls show a ripple pattern on the side and clear grain structures elsewhere. There appears to be a cavity in the first ball evident on the top lower surface in the direction of increasing degrees. After each bridge, the gap tends to widen then narrow to a kerf which then tends to taper somewhat in width and also in the amount of molten metal that is piled up on each edge. This situation continues until the next bridge.

There are a total of 5 ball bridge regions. Each is quite similar in appearance to the first one described. Each bridge also appears to contain the cavity region described for the first ball. The bridges get progressively closer to one another along the length of the specimen. After the last bridge, there is a region that extends for about 9 millimeters with a hole at the end of this region. At this point, the weld itself starts. This weld is extremely uniform; one can see both the ripples and the surface grain structure quite readily. This weld continues on through to the termination point. At approximately 185 degrees, there is a single surface depression on the inside edge of the weld. In the region where the molybdenum tracer is placed on the disc, there is the appearance of under cut having started on both the inside and outside edges of the weld. Also within the tracer region, there is a change in the width of the weld bead with it becoming narrower at the point where the thickness of the disc increases. The slight undercut condition appears to continue on to the termination of the weld at the termination hole. There were no cracks or other defects aside from the single surface depression noted in examination of this weld.

Additional examination of the area where the slight depression was noted on the inside surface of the weld suggest that there may have been a defect in the plate material at that point. This would appear to be a slight machining gouge.

Back Side of S/N 145

Starting in the weld target area on the reverse side of the target, there is evidence of complete penetration. In fact, there appear to be two separate spot areas which were melted through to the back side and subsequently solidified. Surrounding the target area and still attached to the disc are a number of small spherical particles which are probably tantalum spatter that was ejected from the back side of the target area, bounced off the support plate, and then adhered to the tantalum. At least

8 of these small spheres can be seen in the field of view of the magnifying system. Moving away from the target once the beam-travel combination was initiated, penetration stopped until the thin section was reached at which point cutting action was initiated. The back side of the cut region does not appear to be significantly different from the front side with all of the same basic features being evident. The balls that constitute the bridges are raised above the bottom surface just as they were raised above the top surface on the front of the disc. Material present adjacent to the balls in the direction of increasing angle appears to have been pulled back into the bridge area. Appearance on the underside of the full penetration welds is quite similar to the appearance on the upper surface. The full penetration weld begins to taper after its initiation and there is no more penetration after about 135 degrees. Evidence of the presence of the weld continues as in the case of the stainless steel without full penetration being apparent. There is one short linear indication of full penetration at about 225 degrees. Some further evidence of welding is apparent on the reverse side even in the partial penetration region leading up to the termination hole. At the termination hole itself, there is evidence of penetration through the plate on the side where the weld was terminated. At the dwell region, there is no evidence of complete penetration although again, the grain structure and a surface roughening are quite evident.

Front Surface of Disc S/N 147

The electron beam was initiated almost exactly at the center of the target. A weld is started at this position and runs to the point where cutting begins. The cut is initially fairly wide (3mm) and there are small molten balls collected on the edges along this initial region. The cut varies in width between 1 & 3 mm. The first two balls are on the inside of the cut, the next outside, then one inside, then one out, and two more inside. Following this region of the cut, there are bridges apparent, the first bridge existing at 75 degrees. There are a total of 10 bridges before welding starts. The bridges appear to get progressively smaller in size and closer together. Compared to the bridges on SN 145, the bridges on S/N 147 do not appear to be as large or quite as spherical in shape. There is evidence of the same type of cavity on the top lower surface in the direction of increasing degrees as seen in S/N 145. The weld starts at approximately 130 degrees. The weld is uniform; about 2 mm wide, one can see both the ripples and the surface grain structure quite readily. This weld continues on through the termination point. A surface perturbation occurs at about 180 degrees which is the point where a mass shift occurs. There is a slight depression in the weld as it enters the partial penetration region but this is quickly lost. The weld narrows slightly,at this point to 1 mm., and is quite uniform in appearance on to completion. The weld goes on to the termination hole and also slightly beyond on the opposide side. The ripple pattern is not entirely uniform, being somewhat asymmetrical and displaced with its apex offset toward the inside of the disc[(a)]. The dwell region is located inside the intended target, but almost exactly on center of the inside leg of the molybdenum tracer. The dwell is almost rectangular in shape with a center cavity and an apparent pore in the center region. There is no evidence of the ripple pattern on the dwell zone. Grain boundaries coming in from the base metal can be clearly seen to extend on to the surface of the molten zone. The dwell is 5 X 6 mm.

Back Side of S/N 147

Starting at the target position there is evidence of complete penetration through to the back surface of the disc. The cut begins at the transition to the thin section. The molten balls are evident on the rear of the plate and in addition, the same type of shrinkage cavity mentioned earlier on the bridges can be seen in these balls on the under surface. At the start of welding, both the ripple pattern and grain structure are quite evident. The ripple pattern on the under side is perfectly symmetrical with its apex along the weld centerline.[(b)] The weld appears quite uniform in appearance and in width. The same mass shift perturbation noted on the top surface is again noted on the under surface at 180 degrees. The weld continues throughout the intended full penetration region, but does not penetrate completely through the partial penetration region. There is a slight evidence of its existence in this region by virtue of a slightly discolored area.

(a) See MSFC photographs 741072-3 or 741072-4.

(b) See MSFC photographs 741073-4 or 741073-5.

Partial melting exists on both sides of the termination hole. In the cut region there appears to be considerable evidence along either side of the weld of some type of vaporization and subsequent deposit. The same appearance is again evident at the position where the perturbation occurs. This vaporization material would appear to possibly come from the backing plate behind the tantalum. The dwell region is completely penetrated with the under side molten zone being essentially a circular region about 3 millimeters in diameter. There is some evidence of surface roughening and grain structure apparent in the heat-affected zone. The under surface appears to be slightly depressed. There is no evidence of ripples being present in this region. Grain boundaries again extend in from base metal grain boundary regions to the molten zone.

Sectioning

Both tantalum discs have been sectioned as shown in Figure IV-15. An additional section was taken on these discs to include a bridge in the cut area. All sections have been mounted and examination is proceeding. Results of these examinations will be reported in the future.

A. Radial (Transverse ...)

3. ... pen
4. ...
1. ...

... bridge

B. Chord (Longitudinal ...)

2. Dual
5. Full pen
6. Full pen

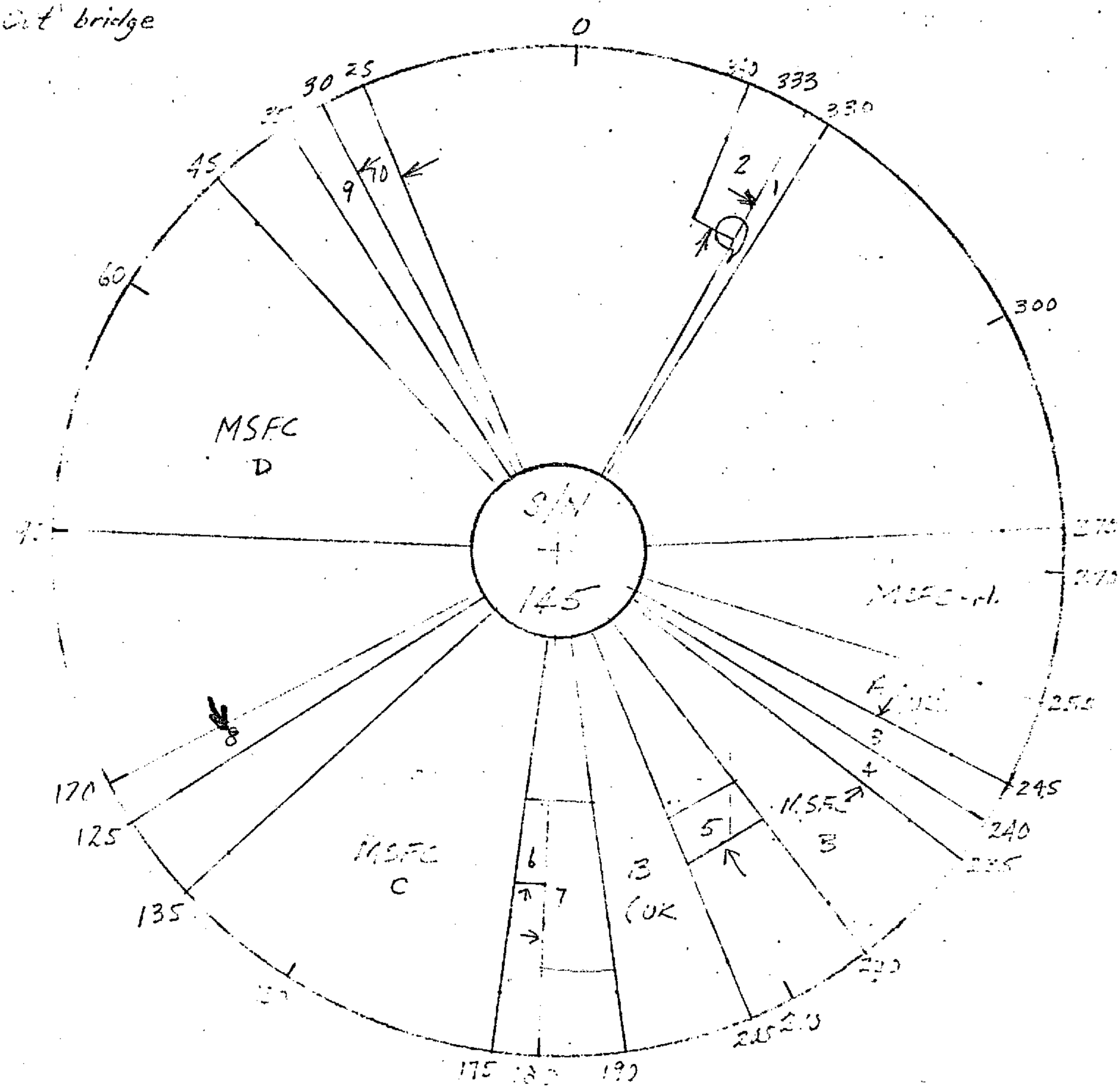


Figure 10-15

FIGURE I-V. SECTIONING PLAN S/N 145 & S/N 147

CONCLUSIONS

The initial examination of Skylab and post flight ground characterization samples indicates one significant observations that appears to relate to gravitational differences. This is the difference in aluminum oxide distribution on the front surface of the weld. It appears that contrary to most expectations gravity induced convection did play a significant role in determining the aluminum oxide distribution on ground characterization samples but not on the Skylab sample.